The Timing of Prenatal WIC Participation

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Abstract:

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides food vouchers, nutritional counseling, and health care referrals to low-income pregnant and breastfeeding women and their young children. This paper uses duration models to study the factors that influence the timing of prenatal WIC participation among pregnant women. The estimates show that Hispanic women, women with low levels of education, women who have no private insurance, and women who are overweight participate in WIC earlier than others. WIC program rules such as allowing applicants to self-declare income and linking WIC eligibility to Medicaid eligibility are related to earlier participation for women experiencing their first pregnancies. Extending the analysis to women pregnant for the second time shows a strong relationship between WIC participation during the first pregnancy and the timing, and likelihood, of participation during the second pregnancy.

Keywords: WIC program | duration analysis | survival analysis | pregnancy

Article:

INTRODUCTION

Administered by the U.S. Department of Agriculture, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides vouchers for healthy food, nutritional counseling, and health care referrals to “nutritionally needy” low-income pregnant and breastfeeding women and their young children. The program began in 1974, and by 2002 it served 7.5 million people each month at an annual cost of $4.5 billion (USDA 2004). Many studies examine the effect of WIC participation on infant health (e.g., Gordon and Nelson 1995, Brien and Swann 2001, Kowaleski-Jones and Duncan 2002, Bitler and Currie 2004), child health (e.g., Carlson and Senauer 2003), and numerous other health outcomes (e.g., Rush 1988, Gordon and Nelson 1995), but little research has addressed the decision to participate in WIC or the timing and duration of participation by pregnant women.

Differences in the decision to participate and the timing of participation may exist for a number of reasons, including a lack of information about the program and participation costs such as crowded waiting rooms and long waits for service.[1] Ku (1989) and Gordon (1996) use logit models and data on WIC recipients to study the decision to participate in WIC in the first trimester as opposed to later in the pregnancy.[2] The each find that past participation in WIC is associated with an increased likelihood of first trimester participation. Gordon (1996) also finds that a number of demographic variables are correlated with the decision to participate during the first trimester. Because they focus only on WIC recipients, these studies do not incorporate non-participation by eligible women, an important omission because the participation rate by eligibles is about 60% (see below and Bitler, Currie, and Scholz 2003).

Increasing early participation by pregnant women is important because a number of studies suggest that earlier participation improves birth outcomes. For example, Devaney, Bilheimer, and Schore (1992) find evidence that early enrollment in WIC leads to larger increases in birth weight than late enrollment, and Ahluwalia et al. (1998) show that the birth weight distribution for early WIC participants is shifted to the right when compared to the distribution for later entrants or non-participants. More recently, Lazariu-Bauer et al. (2004) find increases in mean birth weight related to early (first trimester) WIC participation of 70 grams for full-term pregnancies and 129 grams for pre-term births. The estimated improvements are somewhat larger for blacks and Hispanics than for whites. Thus the evidence suggests that early participation benefits all children with larger benefits for those who are most disadvantaged.[3]

This paper improves upon earlier work by looking at both the timing of participation by participants and non-participation by eligibles and by focusing on monthly participation rather than "early" versus "late". Survival analysis is used to examine the relationship among recipient characteristics, state characteristics, WIC program rules, and the timing of participation.[4] A particular focus of the paper is on the role played by a number of WIC program rules and characteristics. This focus is useful because it sheds light on the degree to which policy-makers can exert influence of participation decisions by changing particular policies.

I find that that women with low education, low income, no insurance, and poor health participate earlier than other women. Automatic eligibility for Medicaid recipients is associated with earlier participation in WIC; the ability to self-declare income and the relative availability of WIC clinics are associated with earlier participation for women experiencing their first pregnancy; and automatic eligibility for AFDC recipients is associated with earlier participation. The results also show that WIC participation during first pregnancies is strongly correlated with earlier WIC participation during second pregnancies.

DATA

NATIONAL MATERNAL AND INFANT HEALTH SURVEY

The primary data for this analysis come from the 1988 National Maternal and Infant Health Survey (NMIHS).5 The NMIHS was conducted by the National Center for Health Statistics in order to study adverse pregnancy outcomes. The sample frame is all women who experienced a live birth, fetal death, or infant death in 1988, and the data set contains information on 9,953

women who had live births; 3,309 women who experienced fetal deaths; and 5,332 who experienced an infant death.[6] Although collected in 1988, these data are wellsuited for this study for a number of reasons. First, the purpose of the original data collection was to study adverse pregnancy outcomes. Consequently, the NMIHS contains a great deal of information related to pregnancy, such as gestational age at birth. Second, a number of questions focused specifically on WIC participation. Most relevant for this study, women were asked whether they received WIC food in each month of their pregnancy. From these data it is possible to construct a month-by-month history of WIC participation for the 1988 pregnancy. The NMIHS also includes detailed demographic information such as age, education, and race; information on the mother's behavior during the pregnancy (e.g., whether she worked); household income; and state of residence. Lastly, although the WIC program (and transfer programs in general) has changed since 1988, the age of the data prove helpful in one respect.[7] In recent years, a number of program rules have been changed to make WIC more consistent across the states. Using data from the period prior to the rules changes makes it possible to understand the consequences of the rule changes.

This analysis uses data on live births and infant deaths. Fetal deaths are excluded because the reporting of fetal deaths is not standardized across states and the data were not collected for a number of states. Infant deaths and live births were sampled at different rates (infant deaths were oversampled in order to obtain meaningful samples of these rare events). The data set includes weights to adjust for the differential sampling rates, and these weights are used in the analysis. To construct the analysis sample, I exclude observations with missing information on any of the variables used in the analysis resulting in a sample of 12,206 women.

In constructing the estimation data, I confront two issues. First, the data include information on month of WIC participation while gestational age at birth is in weeks. For some of the analysis it is helpful to have these variables in the same units. In these cases, I assume that each month is four and one-third weeks long (and round the resulting fractions to whole months) and that women start participating on the first week of each month.

The second issue is how to determine eligibility for WIC. There are three eligibility criteria for WIC: categorical, income, and nutritional. Because pregnant women are categorically eligible, all women in my sample meet this criterion. To qualify on the basis of income, an applicant's income must be less than 185% of the federal poverty guideline.[8] The NMIHS reports a number of income variables including household income in dollars for a number of sources and bracketed overall household income (i.e., indicators equal to one if household income is between $0 and $5,000; $5,001 to $10,000, etc). To determine which families are income eligible, the following procedure is used: if actual household income is available, compare this amount to 185% of the poverty line; if income is less than the cutoff, the family is eligible.[9] If the actual income is missing and if bracketed household income is available, use the midpoint of the relevant income bracket as the measure of income and make the same comparison. Finally, if no income measure is available, then the observation is dropped.

The last criteria is that the woman be "at nutritional risk". Nutritional risk factors include (but are not limited to) medical conditions such as anemia; behaviors such as smoking tobacco or frequent conception; and a past history of low-weight births, pre-term births, or fetal death. I

assume, as is common in the WIC literature, that the nutritional risk criteria are not binding for women who would otherwise qualify. The justification for this assumption is that the nutritional risk criteria are broad enough that any woman who meets the income requirements for the program is essentially certain to meet at least one nutritional risk criterion (Bitler, Currie, and Scholz 2003).

In order to focus on the role of individual and state characteristics as opposed to past experience with pregnancy, or past experience with WIC, much of the analysis is restricted to women experiencing their first pregnancy. For these women, Table 1 presents means of variables used in the analysis for the all women, separately for eligible and ineligible women, and separately for participants and eligible non-participants. The table shows that eligible women are younger, have less education, and are more likely to be black. As would be expected given the means test, eligible women also have lower income, are less likely to be married, and are less likely to be working.

Table 1: Sample Means for First Pregnancies

				Eligible	
	Full Sample	**Eligible**	**Not Eligible**	**Recipients**	**Non Recipients**
Individual Characteristics					
Age	26.169	23.424**	27.765	22.439++	24.724
Years of Education	13.044	11.775**	13.782	11.291++	12.413
Black	0.123	0.233**	0.058	0.282++	0.169
Hispanic	0.090	0.143**	0.059	0.168++	0.110
Other Race	0.043	0.035	0.042	0.038	0.031
Income < $5000	0.099	0.263**	0.004	0.322++	0.186
Income $5000 to $10000	0.091	0.238**	0.005	0.280++	0.182
Income $10000 to $20000	0.189	0.375**	0.081	0.338++	0.424
Insurance	0.645	0.321**	0.833	0.204++	0.475
Works During Pregnancy	0.690	0.541**	0.777	0.482++	0.620
Married at Birth	0.784	0.578**	0.903	0.452++	0.745
Mother Underweight	0.269	0.275	0.265	0.292	0.252
Mother Overweight	0.086	0.090	0.084	0.103+	0.074
Mother Obese	0.084	0.107**	0.070	0.117	0.092
WIC Program Rules					
Can Self-Declare Income	0.301	0.324**	0.287	0.363+	0.274

Link to AFDC	0.442	0.427	0.450	0.434	0.418
Link to Medicaid	0.592	0.579	0.600	0.625++	0.519
WIC Clinics	8.022	7.910	8.090	7.759	8.100
State Characteristics					
Title IV-B	0.912	0.942**	0.895	0.959++	0.921
AFDC Benefit Level	321.124	307.599**	328.990	304.309	311.94
Governor Republican	0.532	0.520	0.539	0.484++	0.567
House Republican	0.129	0.117	0.136	0.089++	0.154
Senate Republican	0.307	0.288*	0.318	0.297	0.276
Unemployment Rate	5.632	5.858**	5.495	6.002++	5.692
Median Education	12.257	12.208**	12.286	12.164++	12.265
Unmarried Birth Rate	0.258	0.257	0.258	0.262++	0.250
Poverty Rate	13.276	13.891**	12.919	14.294++	13.359
Sample Size	7,473	3,682	3,791	2,121	1,561
Population Size	2,231,585	820,613	1,410,972	466,851	353,762

Notes: ** indicates that the mean for eligible women is significantly different from the mean for ineligible women at the 5 percent level of significance; * indicates the same difference at the 10 percent level of significance; ++ indicates that the mean for eligible participants is different from the mean for eligible non-participants at the 5 percent level of significance; + indicates the same difference at the 10 percent level of significance. AFDC benefits are defined for a family of 2, "WIC Clinics" is the number of WIC clinics per 1,000 pregnant women, and "Title IV-B" is spending on Title IV-B spending per 1,000 people.

Turning to participation, Table 1 shows a WIC participation rate of 57% (weighted) which is lower than, but broadly consistent with, Bitler, Currie, and Scholz's (2003) estimate of 66.5% using more recent data.10 Compared to eligible non-recipients, WIC recipients are younger, less educated, more likely to be a member of a minority group, more likely to have low income, and less likely to be married.

Although not used to construct the eligible sample, women must also have some type of documented nutritional risk, and Table 1 shows the fraction of women who are underweight, overweight, or obese—risk factors for WIC eligibility. WIC participants are more likely to be overweight or obese than eligible non-recipients. This suggests that, along this dimension, the WIC program is reaching women who are in poor health. However, almost 20 percent of eligible non-recipients are either overweight or obese, and these women are not being served by the WIC program.

WIC PROGRAM RULES & STATE CHARACTERISTICS

The likelihood of WIC participation and timing of this decision may depend on the ease with which one can apply for WIC and on the general atmosphere toward social programs faced by each recipient. To account for these influences, a number of state-level characteristics are included in the analysis. Some of these variables are related to the WIC program, and some are not. Three variables describing WIC program rules are constructed using data from the 1988 Survey of WIC Program Characteristics. The first is an indicator equal to one if a recipient may self-declare income and equal to zero if the recipient must produce income documentation. The last two indicators are equal to one if the states make AFDC or Medicaid recipients automatically eligible for WIC (also known as "adjunctive" eligibility).[11] A fourth variable, the number of WIC clinics per 1,000 pregnant women, characterizes the availability of WIC. Descriptive statistics for these variables are included in Table 1. Being able to self-declare income and being automatically WIC-eligible if receiving AFDC or Medicaid both lower the cost of participation, and these statistics show that recipients are more likely to live in states where these barriers are lower.

Additionally, a number of variables that describe the states more broadly are included in the analysis. These include measures of the generosity of programs that affect child wellbeing (the maximum AFDC benefit for a family of two and spending per 1,000 people on Title IV-B of the Social Security Act), measures of the political environment (indicator variables equal to one if the governor is a Republican, if the state assembly is controlled by Republicans, and if the state senate is controlled by Republicans), measures of the economic climate in the state (the unemployment rate, the poverty rate, median education), and cultural norms (the fraction of children born out of wedlock).

DESCRIPTIVE STATISTICS FOR WIC SPELLS

The focus of this paper is the timing of entry into WIC, and Table 2 presents information about the timing of entry for women experiencing a first pregnancy in 1988. Because all of the analysis uses sample weights, I focus on the last column of the table. It is clear from that there is substantial heterogeneity in timing of entry into WIC. It is not the case that women begin participating in the first month or two or that most women begin participating in the last month.[12] It is also worth remembering that this table focuses on those women who ever participated. Approximately 43 percent of eligible women did not participate at all.

Table 2: First Month of WIC Participation

	Sample		**Population**	
First Month	**Number of Recipients**	**Fraction of Recipients**	**Number of Recipients**	**Fraction of Recipients**
1	341	0.161	63,349	0.136
2	339	0.160	66,369	0.142
3	482	0.227	100,853	0.216
4	345	0.163	71,593	0.153

5	229	0.108	52,522	0.113
6	158	0.074	39,905	0.085
7	87	0.041	34,653	0.074
8	56	0.026	19,367	0.041
9	84	0.040	18,239	0.039

EMPIRICAL ANALYSIS

Survival analysis is used to study the waiting time until some event occurs. It has been used to study unemployment spells, AFDC spells, and the waiting time until marriage among many other topics. In this case the object of interest is the waiting time until WIC enrollment. Two concepts are key to understanding survival analysis, the hazard rate and the survivor function. The *hazard rate* for beginning a WIC spell at time (month) *t* is defined as the probability that a woman enters the WIC program at time *t* given that she has not done so before this time. Thus, the hazard rate for entering WIC during the second month of the pregnancy is the probability that a woman who did not participate in WIC during the first month of her pregnancy begins to participate in the second month. The *survivor function* gives the probability that a woman has not yet entered the WIC program at some time *t* – it is the probability that she "survives" in the nonparticipation choice.

MODEL SPECIFICATION

I begin by specifying a proportional hazards form for the hazard function:

$$(1) \qquad \lambda_i(t) = \exp\{X_{it}\beta\}\lambda_0(t)$$

where *Xit* is a vector of observed characteristics for woman i at time t, β is a vector of parameters that describe the effect of these characteristics on the hazard rate, and λ0 (*t*) is the "baseline" hazard.

The baseline hazard describes how the hazard rate changes over the course of a spell. For some problems one might expect the hazard rate to either increase or decrease as spell length increases. For example, the probability of leaving the unemployment insurance program may rise as spell lengths increase and recipients near the exhaustion of benefits. Unlike that case, there is no compelling reason to believe the hazard rate into WIC would monotonically rise or fall over the course of the pregnancy.

A number of commonly used baseline specifications (e.g., the Weibull, Gompertz, lognormal, and log-logistic) are available, but each of these specifications imposes potentially important restrictions on the shape of the baseline hazard. For example, the baseline hazard in the Weibull model can only be monotonically increasing or decreasing. To allow for more flexibility, I specify the baseline hazard as a step function that can change in arbitrary ways (Meyer 1990). Because there are only nine potential entry points, I specify a discrete time hazard function and

assume the hazard rate remains constant during each month. The hazard function for this model may be specified as

$$(2) \qquad \lambda_i(s) = \exp\left\{ X_{is}\beta + \sum_{j=1}^{9} g_j s_j \right\}$$

where the g's are parameters to be estimated and sj = 1 if s is the j_{th} month and zero otherwise.

The log likelihood function for the discrete time model can be written in terms of the hazard function as

$$(3) \qquad L(\theta) = \sum_{i=1}^{N} \log\left((1-c_i)\left[\exp\left\{ -\sum_{s=1}^{t_i-1} \lambda_i(s) \right\} \left[1 - \exp\{-\lambda_i(t_i)\} \right] \right] + c_i \exp\left\{ -\sum_{s=1}^{t_i} \lambda_i(s) \right\} \right)$$

where Θ is a vector of all of the unknown parameters in the model (the β 's, and the g's), i indexes individuals, ci = 1 if person i's spell is censored and = 0 otherwise, and *ti* is the time the spell is censored or the mother enters WIC as appropriate.

IDENTIFICATION STRATEGY FOR EFFECTS OF PROGRAM RULES

A goal of this paper is to understand how various WIC program rules affect the timing of participation. Providing a causal interpretation to state-level policies is difficult when using cross-sectional data because the only policy differences are between states. If state level policies reflect other unmeasured characteristics of the state, then estimates of the effect of WIC policies will include a casual component and a component due to the underlying state characteristics that were excluded from the analysis. Ideally, panel data, along with changes in program rules over time within states, makes it possible to identify the effects of the policies while controlling for unmeasured (constant over time) state characteristics.

The absence of panel data necessitates a different approach. Because the identification problem results from omitted variables, the first specification includes, in addition to individual characteristics and WIC program rules, an array of state level variables to capture the economic and political environment in the state. This specification establishes a baseline estimate of the effect of program rules in the absence of any geographic controls. Because the absence of panel data precludes state fixed effects, the next two specifications add different region-level indicator variables. Specifically, the second specification adds indicators for the four census regions to the model, and the third specification replaces the four region indicators with indicators for the nine census divisions. Table 3 lists the states, census regions, and census divisions.

An example will help clarify what is required for identification. Texas and Oklahoma are both in the "West South Central" Census Division, and Oklahoma allows self-determination of income while Texas does not. To the extent that, after controlling for a number of state-level differences, Texas and Oklahoma are similar in unobserved ways, differences in the timing of participation in those states can be attributed to differences in the ability of women to self-declare income.

Although there is no formal identification test for this strategy, an informal test is the degree to which the estimates vary across the different specifications. Specifically, estimates that remain constant as region effects are added are more consistent with a causal interpretation than are estimates that change dramatically as region effects are added.

Table 3: Census Regions and Divisions

Census Region	Census Division	States
Northeast	New England	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
	Middle Atlantic	New Jersey, New York, Pennsylvania
Midwest	East North Central	Indiana, Illinois, Michigan, Ohio, Wisconsin
	West North Central	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
South	South Atlantic	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia
	East South Central	Alabama, Kentucky, Mississippi, Tennessee
	West South Central	Arkansas, Louisiana, Oklahoma, Texas
West	Mountain	Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming
	Pacific	Alaska, California, Hawaii, Oregon, Washington

RESULTS FOR FIRST PREGNANCIES

The results for the three different specifications discussed above are presented in Table 4. The coefficients reported are hazard ratios. For example, in Specification 1, the coefficient on "Hispanic" of 1.420 means that the hazard rate for someone who is Hispanic is 1.420 times as large as it is for someone who is otherwise identical except that she is white (the base category for race).

In general, the coefficients on the non-WIC state characteristics become smaller and are less likely to be statistically significant when region indicators are included. For example, the results

in Specification 1 suggest that an increase in the unemployment rate is associated with an increase in the hazard rate. However, once we control for region effects, this result becomes smaller and statistically insignificant. Thus, even though the unemployment rate matters at the national level, within regions there is no relationship between unemployment rate and the timing of WIC participation. Because the estimates for the non-WIC state characteristics are sensitive to the inclusion of Census region and division variables, this finding suggests that these coefficients should not be interpreted causally.

This pattern for non-WIC state characteristics can be contrasted with the results for the WIC program rules which are relatively constant and retain their statistical significance as region and division indicators are added. Comparing Specifications 1 and 3, the estimated effect of the ability to self-declare income increases as region indicators are added while the estimated effects of clinics and adjunctive eligibility for Medicaid recipients fall by small amounts but remain statistically significant. Although it is not possible to extrapolate to the case where state effects are included in the model, this result suggests that these characteristics of the WIC program are related to the timing of WIC participation.

Table 4: Flexible Baseline Hazard Model – First Pregnancies

	Specification		
	1	**2**	**3**
WIC Program Rules			
Self-Determine Income	1.319**	1.332**	1.422**
Link to AFDC 1.052	1.085**	1.030	
Link to Medicaid	1.227**	1.274**	1.165**
Clinics	1.019**	1.014**	1.017**
Individual Characteristics			
Age	1.063**	1.057**	1.057**
$Age^2/100$	0.858**	0.865**	0.865**
Years of Education	1.420**	1.427**	1.382**
Years of $Education^2/100$	0.136**	0.133**	0.151**
Black	1.021	1.040	1.056
Hispanic	1.420**	1.416**	1.443**
Other Race	1.907**	1.872**	2.018**
Income < $5000	1.990**	1.960**	1.914**
Income $5000 to $10000	2.126**	2.101**	2.064**
Income $10000 to $20000	1.911**	1.876**	1.879**
Insurance	0.586**	0.588**	0.596**
Worked During Pregnancy	0.858**	0.854**	0.849**
Married at Birth	0.672**	0.685**	0.678**

Mother Underweight	1.141**	1.150**	1.148**
Mother Overweight	1.513**	1.538**	1.524**
Mother Obese	1.541**	1.578**	1.568**
State Characteristics			
Title IV-B	2.644**	2.725**	1.990**
AFDC Benefit Level	0.996	0.953**	0.961*
Governor Republican	0.968	0.934*	0.985
House Republican	0.586**	0.579**	0.569**
Senate Republican	1.085**	0.934	0.951
Unemployment Rate	1.027**	1.006	1.016
Median Education	1.087	0.911	0.925
Non Wedlock Birth Rate	1.448	0.996	0.655
Poverty Rate	0.983**	0.988	1.003
Region Effects	No	4 Regions	9 Regions
Likelihood	-9,291.20	-9,284.76	-9,267.76

Notes: Coefficients are reported as hazard ratios. ** indicates a variable is statistically significant at 0.05. * indicates a variable is statistically significant at 0.10. “AFDC Benefit Level” is defined for a family of 2, “Clinics” is the number of WIC clinics per 1,000 pregnant women, and “Title IV-B” is spending on Title IV-B spending per 1,000 people.

To better understand the magnitude of these estimated effects, Figure 1 presents two survivor curves derived from the last column of Table 4. Both curves hold all variables except the “ability to self-declare income” variable constant at their (weighted) sample averages. The curve for “may self-declare income” assumes the average person may self-declare income while the other curve assumes she may not. The higher hazard for women who are able to self-declare income translates into a lower survivor curve. Over the course of a forty week pregnancy, this effect amounts to a 9 percentage point higher likelihood of participation for women who may self-declare income. Figures 2 and 3 repeat this process for adjunctive eligibility for Medicaid and the number of WIC clinics per 1,000 women, respectively. Figure 3 uses the sample minimum of 2.6 WIC clinics per 1,000 women for “Low” and the sample maximum of 20 clinics for “High”. The full term pregnancy participation effect of adjunctive eligibility for Medicaid is about 7 percentage points, and the effect of moving from 2.6 to 20 WIC clinics per 1,000 women is about 10 percentage points.

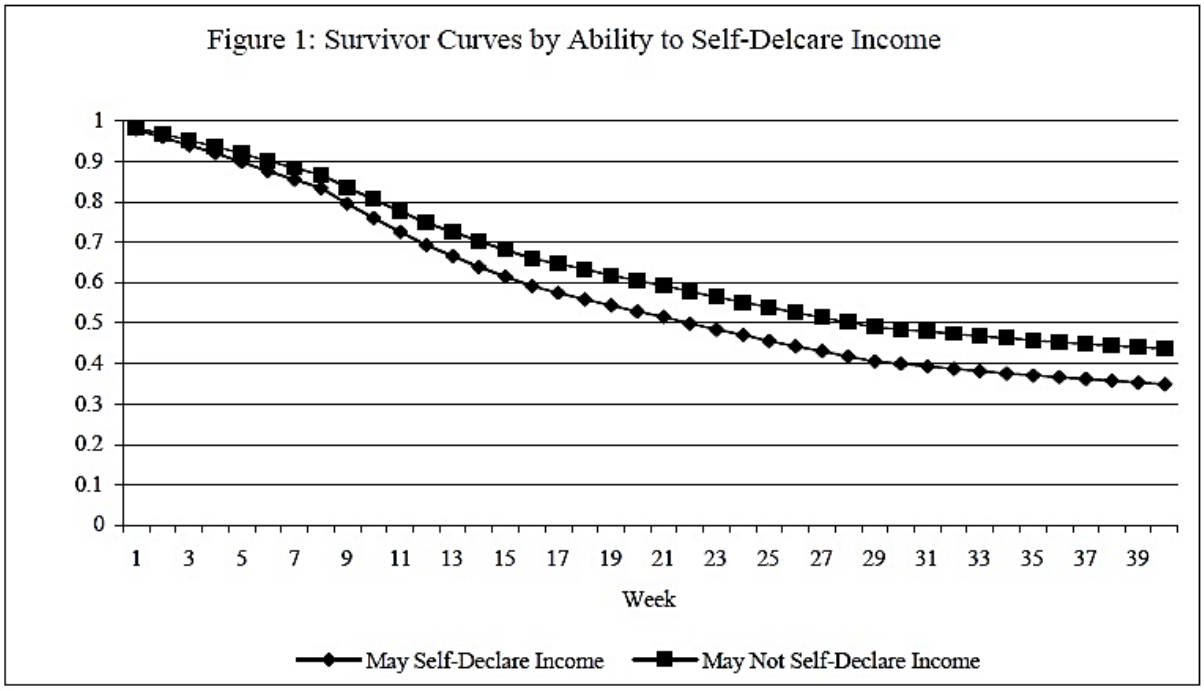

Figure 1: Survivor Curves by Ability to Self-Delcare Income

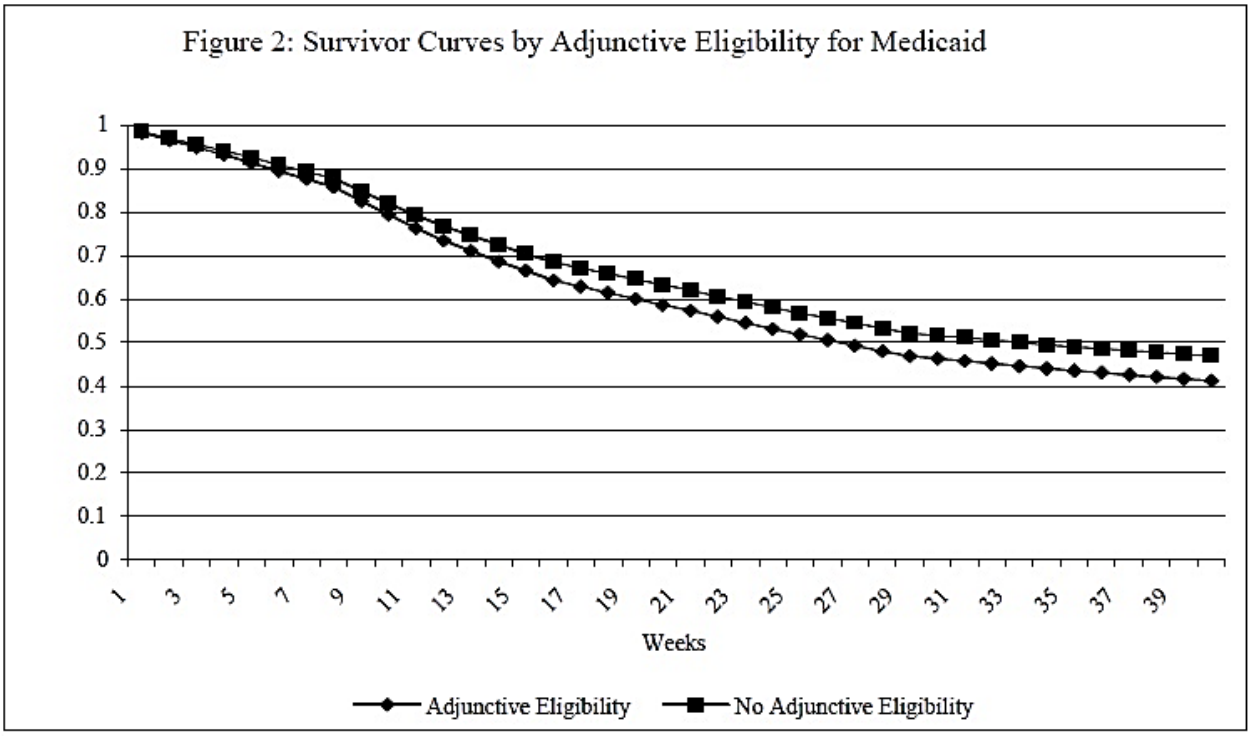

Figure 2: Survivor Curves by Adjunctive Eligibility for Medicaid

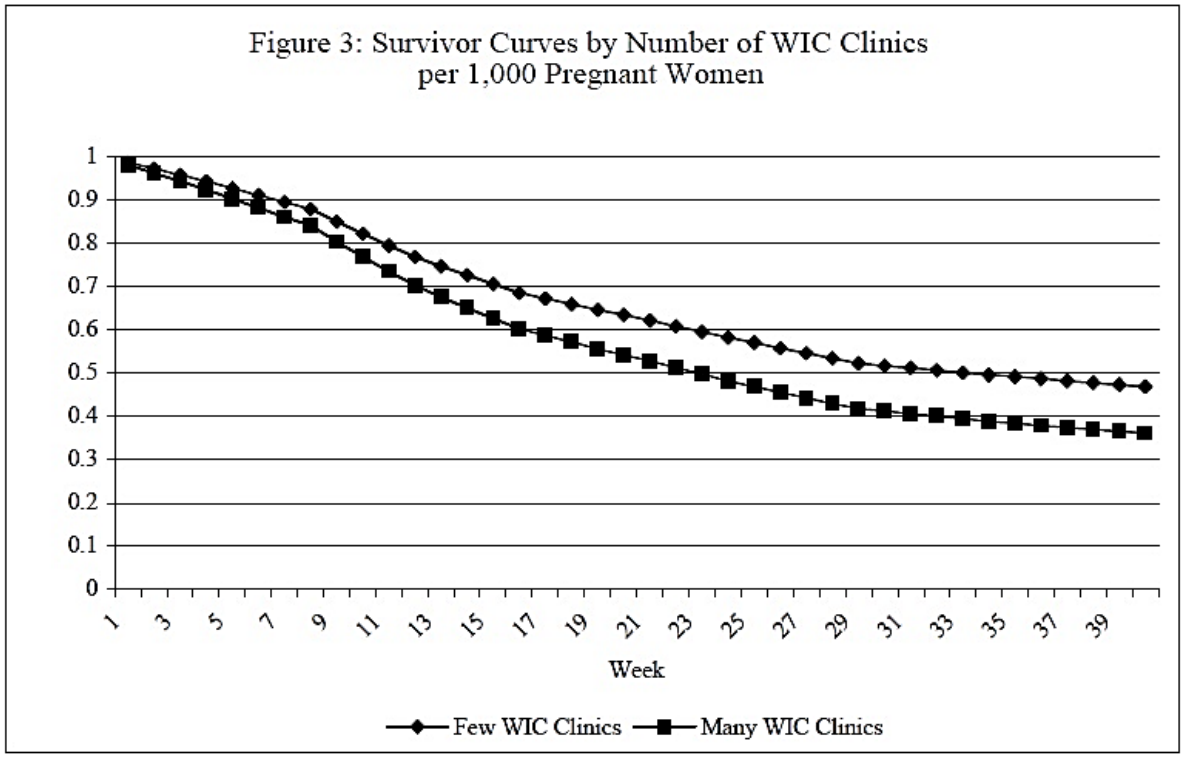

Figure 3: Survivor Curves by Number of WIC Clinics per 1,000 Pregnant Women

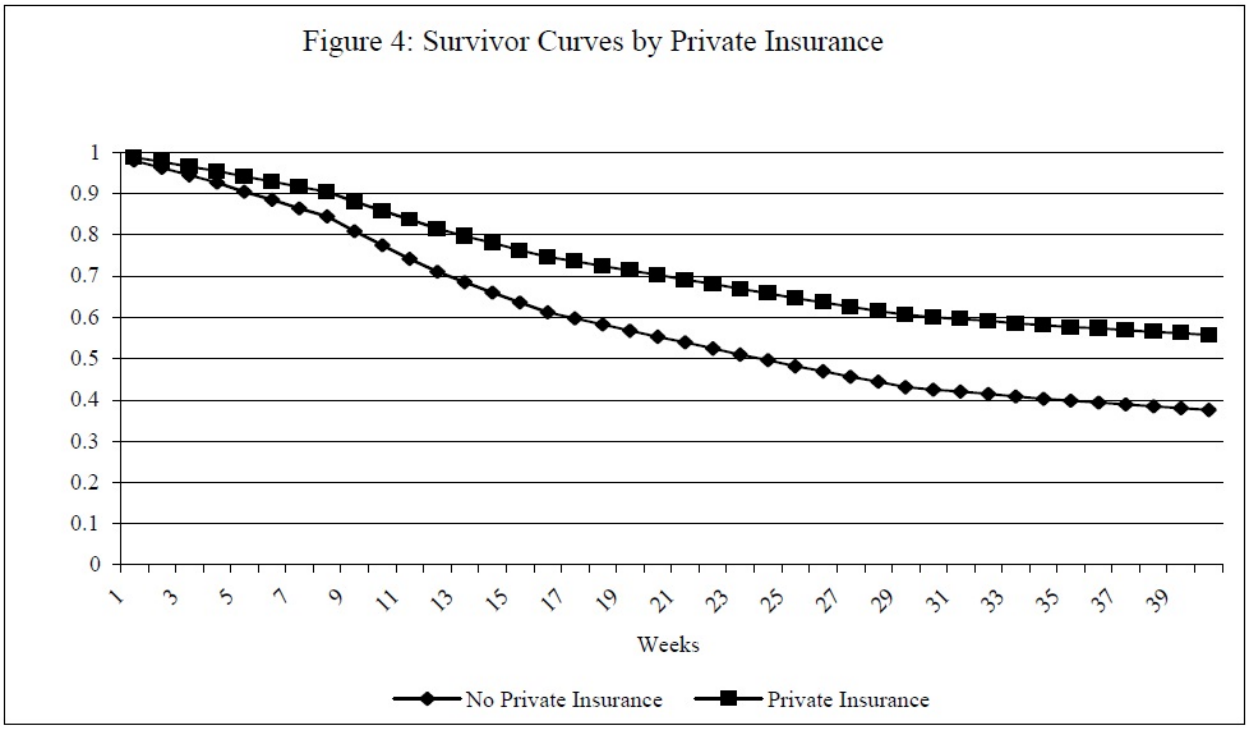

Figure 4: Survivor Curves by Private Insurance

The estimated effects of the individual characteristics are generally consistent with the earlier descriptive statistics and the previous literature. The hazard rate is first increasing and then decreasing in age with a peak at about age 19. It is essentially decreasing in education. Having income below $20,000 increases the entry hazard, but differences in income below that level do not substantially alter the hazard. Being married, working, and having insurance all lower the entry rate into the WIC program. For illustration, Figure 4 shows that having private insurance decreases the likelihood of WIC participation by almost 20 percentage points over the course of a forty week pregnancy. Finally, being underweight, overweight, or obese increase the hazard. The increased hazard for overweight or obese women may represent the direct effect of being overweight as a nutritional risk factor or it may reflect other diseases such as diabetes. Similarly, the higher hazard for underweight women may reflect the direct effect of being underweight as a nutritional risk factor or it may reflect behaviors such as smoking or drug use. As a group, these results point to a negative selection into the WIC program whereby more disadvantaged women (e.g., low education, low income, or lacking insurance) participate earlier than more advantaged women.

To this point, the discussion has omitted mention of the shape of the baseline hazard. The shape of the hazard over the course of a pregnancy is easiest to see using an average hazard function, constructed in the same way as the survivor curves above except that all variables are set equal to their sample average values. The graph of this function is presented in Figure 5. The hazard function a step function with nine different levels corresponding to each month of possible entry.[13]

The most important part of the hazard is it's overall shape. It is increasing over the first three months, particularly the third month, falling over the fourth and fifth months, and then dropping again between months six and seven. The increasing baseline hazard in the first few months is consistent with women participating as they learn they are pregnant or as they initiate prenatal care and seek out additional services. The decreasing hazard may result from unobserved differences across women that are not controlled for in the analysis. For example, for health reasons or preferences toward social programs, some women may be very unlikely to participate in WIC. Suppose that this group has a constant hazard that is lower than the hazard rate of the remaining women (also assumed to be constant). The at-risk sample is a mixture of the two types of women, and over the course of pregnancy, the sample becomes increasingly composed of women who have the lower hazard rate. This change in composition makes it appear as though the hazard rate is falling even though the hazard is assumed to be constant for each individual.[14]

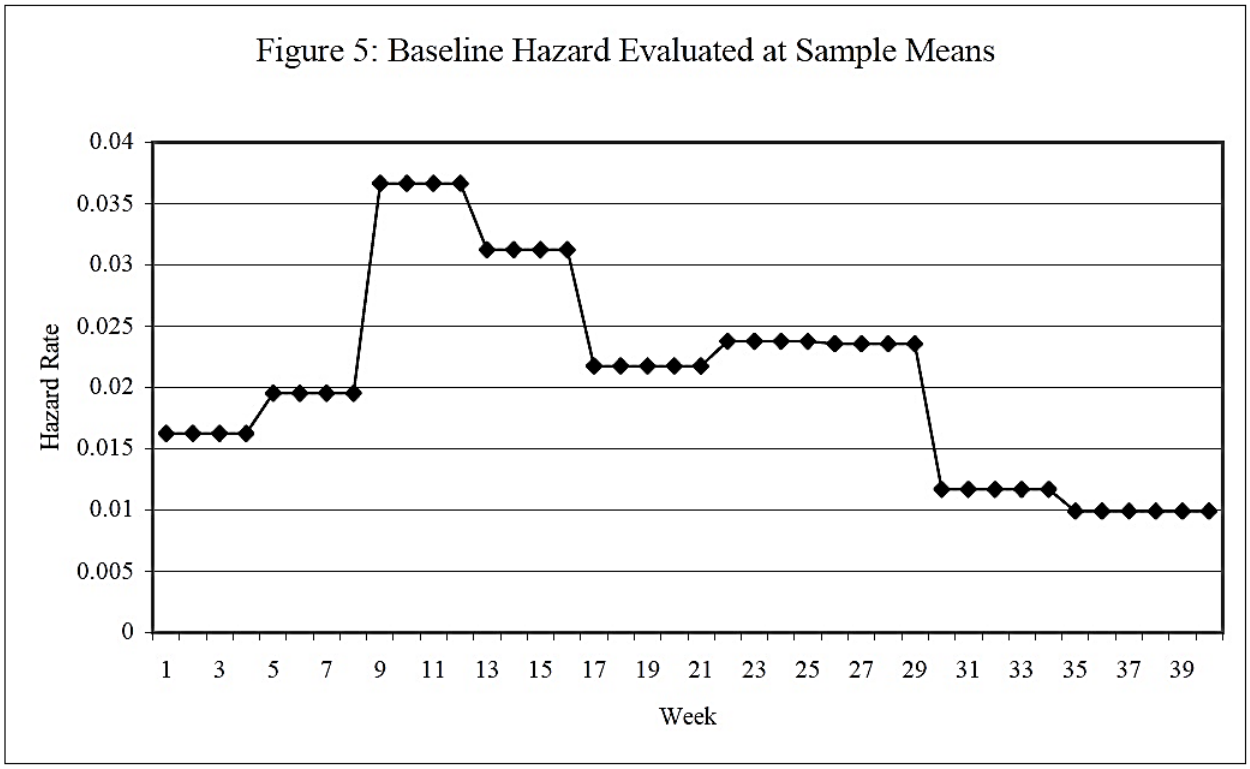

Figure 5: Baseline Hazard Evaluated at Sample Means

SECOND PREGNANCIES AND THE ROLE OF PAST WIC PARTICIPATION

The results for first pregnancies suggest that a number of individual characteristics and state-level rules affect the timing of WIC participation. However, women who have been pregnant in the past may be influenced by past experiences which alter their participation patterns. For example, they may have experienced complications which induce them to participate earlier rather than later, or they may find that their earlier pregnancy went smoothly in which case they may not participate or participate later rather than earlier. Also, women who have received WIC in the past have more information about the program, from its mere existence to an understanding of the rules and procedures. Holding constant their personal experience of pregnancy, this knowledge may induce past recipients to take up benefits earlier than others. Finally, past recipients may differ in their tastes or perceptions of stigma.

Although the available data do not allow a causal analysis of the role of past participation, I briefly explore participation among women who have experience with pregnancy. To limit the amount of heterogeneity across women, I focus on women experiencing their second pregnancies. Consistent with Ku (1989) and Gordon (1996), past recipients are much more likely to receive WIC than are women who did not receive WIC during their first pregnancy: the participation rate is 83% for past participants compared to 40% for past nonparticipants.

Table 5 reports the results (hazard ratios) for women experiencing their second pregnancies. This specification adds an indicator for past WIC participation to the variable list from the last model in Table 4. Compared to the results for first pregnancies, adjunctive eligibility for AFDC and Medicaid are both more important for second pregnancies. In contrast, the ability to self declare income and the number of WIC clinics do not have statistically significant effects for second pregnancies. These different results are consistent with adjunctive eligibility being more important for women who already have children and who are therefore more likely to be involved with the AFDC and Medicaid programs.

Although we cannot give it a casual interpretation, past participation has a large effect on the hazard rate for participation during second pregnancies. Specifically, the hazard rate for past participants is almost three times as large as the hazard for past non-participants.[15] The addition of the past receipt variable has a particularly large effect on the income variables suggesting that low income is proxying for past receipt.

To illustrate the models' predictions, Figure 6 presents the average survivor curves for three groups: first pregnancies (using the estimates from the last column of Table 4), second pregnancies with no past WIC (using the estimates from Table 5 with "Previous WIC" = 0), and second pregnancies with past WIC (using the estimates from the last column of Table 5 with "Previous WIC" = 1). This picture shows that the probability that a previous recipient participates in WIC is about eighty percent over a full term pregnancy (survivor probability = 0.2) whereas a woman who has had one previous pregnancy but not participated in WIC has a participation probability by the ninth month of about forty-one percent (survivor probability = 0.59). The survivor curve for first pregnancies lies between these two cases.

Table 5: Flexible Baseline Hazard Model – Second Pregnancies

WIC Program Rules	
Can Self-Determine Income	0.947
Link to AFDC	1.381**
Link to Medicaid	1.489**
Clinics	1.001
Individual Characteristics	
Age	0.903*
$Age^2/100$	1.190*
Years of Education	0.601**
Years of $Education^2/100$	5.192**
Black	0.855
Hispanic	0.861
Other Race	0.391**
Income < $5000	1.250
Income $5000 to $10000	1.653**
Income $10000 to $20000	1.063
Insurance	0.538**
Worked During Pregnancy	0.730**

Married at Birth	0.674**
Mother Underweight	0.805**
Mother Overweight	1.016
Mother Obese	1.484**
Previous WIC Participation	2.974**
State Characteristics	
Title IV-B	0.947
AFDC Benefit Level	1.088
Governor Republican	0.805**
House Republican	1.510**
Senate Republican	0.819
Unemployment Rate	1.044
Median Education	0.716
Non Wedlock Birth Rate	0.0001**
Poverty Rate	1.082**
Region Effects	9 Regions
Likelihood	-2,442.87

Notes: See notes to Table 4.

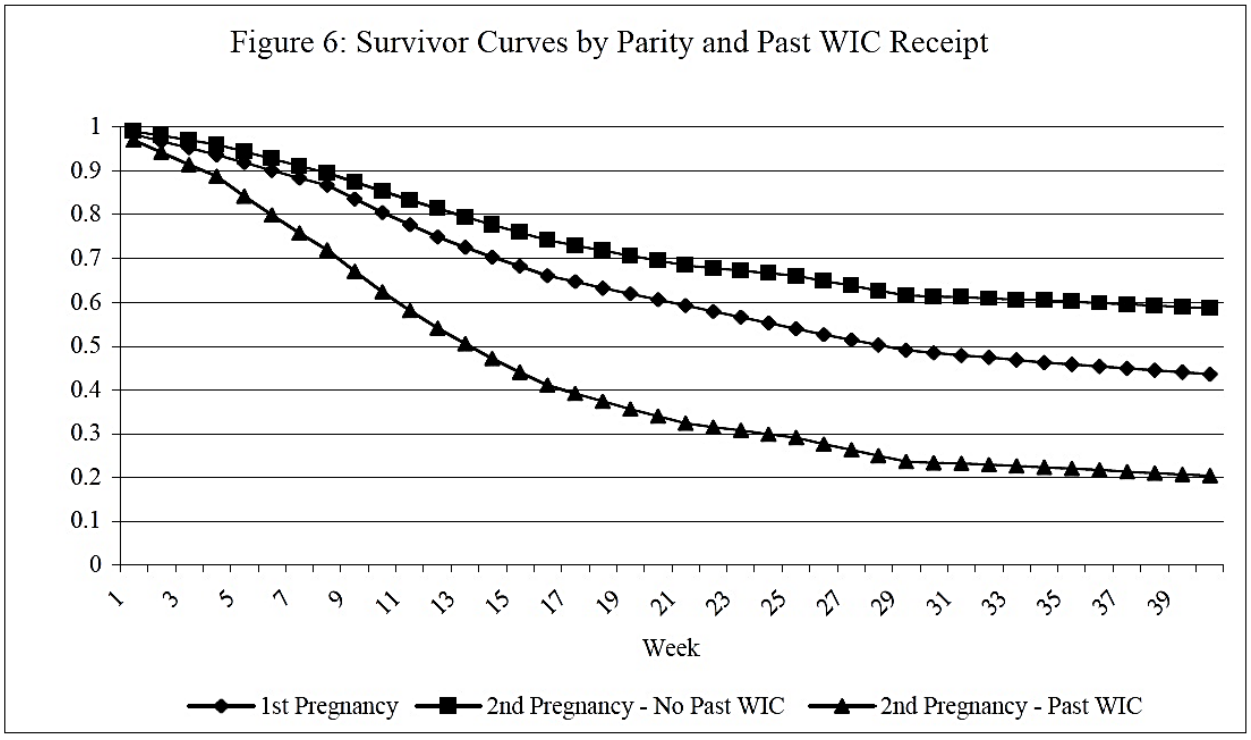

Figure 6: Survivor Curves by Parity and Past WIC Receipt

DISCUSSION AND CONCLUSION

The goal of this is to better understand the roles of maternal and WIC program characteristics on the hazard rate for prenatal WIC participation. Understanding this relationship is important

because there is evidence that early participation in WIC may improve birth outcomes, and understanding the factors related to late (or non-) participation may help improve outreach to women who participate later.

Before summarizing the results and their implications, it is important to note that the data used for the analysis come from 1988 and that there have been a number of changes in WIC and in the overall welfare environment since 1988.[16] The WIC program has undergone changes in rules that have made the program somewhat more standardized.17 For example, as discussed above, it is now the case that recipients in a number of other programs are adjunctively eligible for WIC and that recipients cannot self-declare their income, but in 1988 it was up to states whether recipients in other welfare programs were adjunctively eligible for WIC and whether applicants could self-declare income. Using data from prior to the program changes makes it possible to understand the possible effects of these program changes on the likelihood and timing of participation. Figure 7 presents expected survivor curves (for first pregnancies) for the 1988 policies where income declaration and adjunctive eligibility were determined by the states and for current policy. This figure shows that the two reforms have small and essentially off-setting effects such that the net effect is a very small increase in the survivor probability.[18] It is also small because only part of the population was affected by the reforms. Figures 1 to 3 provide evidence on the size of the effect of a change in a single policy for the whole population.

Furthermore, the overall welfare environment has changed since 1988. Two changes are particularly relevant. First, expansions to the Medicaid program have increased the number of women who are eligible for Medicaid. Combined with universal adjunctive eligibility, this has increased the pool of women eligible for WIC and the number of women with higher incomes who are eligible for WIC. However, administrative data for the year 2000 show that of the 87% of pregnant women for whom data were available, over 98% had incomes less than 185% of the poverty line (USDA 2002). This suggests that the eligibility expansions have not dramatically affected the income composition of WIC recipients. Second, AFDC has been replaced with the Temporary Assistance for Needy Families (TANF) program with its state flexibility and federal time limit. This change, along with the economy of the late 1990's, resulted in a large reduction in the number of women receiving AFDC/TANF and food stamps, and it coincides with a reduction of WIC recipients from 1998 to 2000. However, it is important to understand that the number of welfare recipients fell by almost 37% between 1998 and 2000 while participation in WIC fell by less than 3%. As would be expected given the overall decline in welfare utilization, the fraction of WIC recipients who received TANF and food stamps fell over the period 1998 to 2000. Further insight is provided by Lee, Mickey-Bilaver, and Goerge (2003) who examine WIC, food stamp, and AFDC/TANF participation of children in Illinois. They study 1990 to 1996 birth cohorts and find that fraction of children who have ever participated in WIC by age 2 increases from 47.4% for the 1990 birth cohort to 52.7% for the 1996 birth cohort compared to similar participation changes of 30.8% to 23.7% for AFDC/TANF and 34.8% to 29.0% for food stamps. These results suggest that some recipients who are no longer receiving cash assistance or food stamps turn to WIC for assistance.

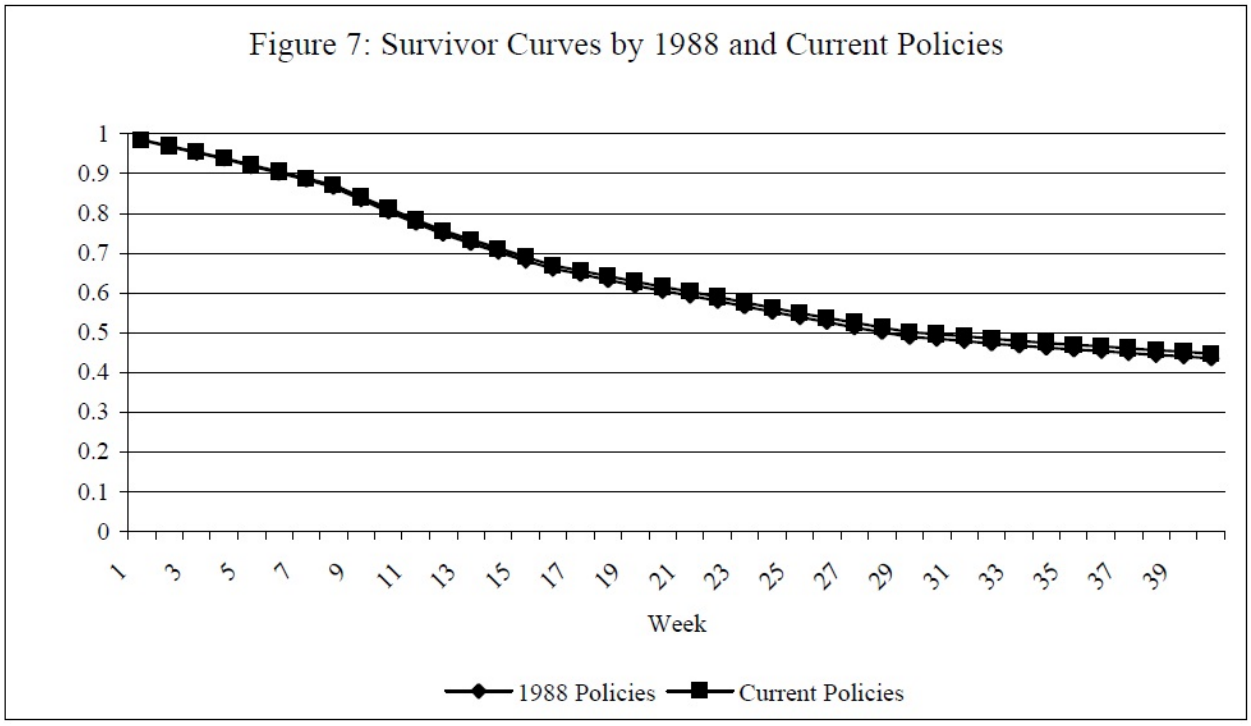

Figure 7: Survivor Curves by 1988 and Current Policies

Taken as a whole, the changes to Medicaid and the switch from AFDC to TANF have clearly had an effect on the WIC program, but the changes appear to be more modest than might be expected. Thus, there is reason to believe that the results of the present study are not dramatically affected by welfare reform. Even if one remains concerned about the implications of welfare reform on WIC usage, the present results provide a useful pre-welfare reform baseline with which to compare post-welfare reform.

Turning to the results themselves, I find consistent evidence that women who are Hispanic, younger, less educated, single, and in poor health are more likely to participate and to participate earlier. This finding has important implications for outcomes studies that have been concerned about possible nonrandom selection into WIC (for example, Gordon and Nelson 1995, Brien and Swann 2001, Bitler and Currie 2004). The outcomes literature has been concerned with whether selection on unobservables exists and whether it is negative or positive. The answers to these questions are important because they determine whether OLS is appropriate and, if it is not, whether OLS estimates under or over estimate the effect of WIC on birth outcomes. If, as seems likely, women who are negatively selected on many observed characteristics are also negatively selected on unobserved characteristics, this paper suggests that OLS estimates underestimate the effect of WIC on birth outcomes. It does not, however, shed light on whether selection on unobservables exists, only that if it does exist, it is likely to be negative.

The analysis of WIC program rules suggests that barriers such as income documentation and availability of clinics are important for women experiencing their first pregnancies but that adjunctive eligibility for other transfer programs is important for women who already have

children. Thus, in the context of the current rules, outreach toward women pregnant for the first time may be particularly important.

Finally, the age of the data used in this study point to the need for collection of data that can be used to explore this and similar issues. Issues that are commonly studied in other programs, such as repeat spells of participation, are not easy or possible to study using currently available data.

Notes

1 A number of papers (e.g., Rosenberg, Alperen, and Chiasson 2003, McKinney 2004, and Woelfel et al. 2004) explore the reasons why eligible women do not participate at all or do not participate fully in WIC.

2 Although not focusing on participation, Brien and Swann (2001) and Bitler, Currie, and Scholz (2003) estimate simple models of the decision to participate in WIC at any point in a pregnancy but not the timing and duration of participation. Gordon and Nelson (1995) provide descriptive information about the month when participation began and the number of months of participation, but they do not model the behavior.

3 That early initiation of WIC is a good thing is also suggested by the prenatal care literature where adequate care is defined in part by early initiation (Kessner 1973; Kotelchuck 1984). See also Luke et al. (1993).

4 Survival analysis techniques are used to study the time that elapses until some event occurs. It has an advantage over regression analysis for these problems because it allows for censoring (in this case the fact that a substantial portion of women do not participate in WIC). Survival analysis has been used to examine participation in other welfare programs including AFDC (Blank 1989) and Medicaid (Black and Berger 1998). Lancaster (1990) provides an overview of these methods.

5 More recent data sets such as the SIPP were considered. Unfortunately, while it is possible to count backwards from the birth of a child in the SIPP to make inferences about prenatal WIC participation, it is not possible to study the timing of the initiation of care because there is no data on gestational age at birth.

6 The median interval between the pregnancy outcome and the survey was 16 months. See Sanderson, Scott, and Gonzalez (1998) for detailed information about the NMIHS.

7 Issues raised by changes in WIC and welfare programs more generally are discussed in the conclusion.

8 Even if their income is above the poverty guideline, some women may still pass the means test through a process known as “adjunctive” eligibility. In 1988, some states automatically deemed recipients of other means tested programs automatically eligible for WIC even if their income exceeded 185% of the poverty line. This analysis focuses only on income eligible women.

9 Income is computed as the sum of wage income, AFDC benefits, unemployment insurance, child support, veteran's payments, SSI, and other income. In-kind benefits such as food stamps and public housing are not included. Although eligibility for WIC is based on monthly income, the NMIHS only reports annual income. Thus, a woman who becomes unemployed may appear ineligible to me when she is in fact eligible while a woman whose income increases due to marriage may appear eligible when she is in fact ineligible.

10 This difference may come from a number of sources, and it is not possible to separate out what part of this difference comes from differences in data sources, data quality, modeling assumptions, differences in the population of eligible women, or different welfare environments.

11 States also had the option to make Food Stamp recipients adjunctively eligible. However, after controlling for adjunctively eligible for AFDC recipients, there was insufficient independent variation in Food Stamp eligibility to separately include it in the analysis.

12 These data show more first trimester participation than administrative data. Gordon (1996) examined this issue and concluded that it is likely that some women interpreted the timing relative to when the learned they were pregnant rather than the beginning of pregnancy. It is not possible to deal with directly because we do not know how each woman interpreted the question. It will, however, only affect the shape of the baseline hazard.

13 The flat portions of the hazard are an artifact of having only nine entry points while looking at 40 weeks of pregnancy, and it is very unlikely that the hazard would have flat segments if the week of entry into WIC were known.

14 Because it can be difficult to distinguish the effect of unobserved heterogeneity from a flexible baseline hazard when one only has a single spell of data (as in this case), I do not pursue this issue.

15 Information about past pregnancies is limited, and I am unable to determine eligibility for WIC during past pregnancies. Therefore, all women who are eligible for WIC in 1988 are assumed to have been eligible during their previous pregnancy.

16 It must also be noted that 1988 was the height of the crack cocaine epidemic.

17 Specific WIC regulations can be found the Code of Federal Regulations, 7 CFR, Part 246 and can be accessed at http://www.fns.usda.gov/wic/lawsandregulations/WICRegulations-7CFR246.pdf.

18 It is also worth noting that changes to policy that make participation more difficult, such as requiring income documentation, must be weighed against the possibility of preventing fraud.

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